Air Quality Modelling & Assessment Unit (AQMAU)

Environment Agency

AQMAU reference:	AQMAU-C2179-RP01
Permit reference:	EPR/AP3304SZ/A001
Project title:	Portland Energy Recovery Facility (ERF)
Work title:	Audit of air quality impact assessment
Date requested:	22nd March 2021
AQMAU response date:	6th October 2021

AQMAU recommendation	Conditions / noted
• The applicant should quantify and comment on the modelling uncertainties, re-evaluating predictions (including the use of alternative-modelling software as appropriate) and re-interpreting predicted impacts.	• Software validation documents, our own check modelling, sensitivity analysis, and interpretation of uncertainties indicate that the applicant's predictions are likely to underestimate potential impacts at sensitive receptors.
• The applicant's conclusions cannot be used for permit determination.	Due to underestimated concentrations at the following locations, we cannot rule out a contribution to exceedances of: • Hourly HCl at locations of human exposure at the top of the Isle of Portland for abnormal operations during abatement failure. • Annual and daily NO_X critical levels at the Isle of Portland to Studland Cliffs SAC and Isle of Portland SSSI, where background NO_X already exceeds the annual critical level of 30 µg/m^3. • Nutrient nitrogen deposition minimum critical loads at Chesil and Fleet SAC and the Isle of Portland SSSI (only if woodland features), where background levels already exceed the minimum critical loads.

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1. Summary of work request

1.1 The National Permitting Services (NPS) Bristol Team asked the Air Quality Modelling and Assessment Unit (AQMAU) to audit an air quality assessment[1] (AQA), an abnormal emissions assessment[2] and a human health risk assessment[3] (HHRA) and supporting documents. The assessments support an application from Powerfuel Portland Ltd (the applicant) to operate a proposed energy recovery facility (ERF) on the Isle of Portland, South Dorset.

1.2 Environmental consultants' Fichtner Consulting Engineers Ltd carried out the air quality assessment, whereas Environmental Resources Management Ltd conducted the human health risk assessment on behalf of the applicant (aka the consultant).

1.3 The proposed ERF will process refuse derived fuel (RDF) from domestic (municipal solid waste) and commercial & industrial (C&I) non-hazardous waste at a maximum capacity of approximately 202,000 tonnes per annum. The technology will be based on conventional thermal incineration comprising moving grate furnace, steam boiler and turbine generator to produce electricity and the potential to recover waste heat.

2. Conclusions that lead to AQMAU recommendations

2.1 Within the submitted assessments, the applicant claims that:

- Either Process Contributions (PCs) are below 1% and 10% of the long and short-term Environmental Standards (ES) or Predicted Environmental Concentrations (PECs) are well below the ES for all pollutants. There are no predicted exceedances of any of the short- or long-term ES associated with abnormal operations.
- At all ecological sites where the impact exceeds 1% of the long term or 10% of the short-term critical level or load, the PEC is less than 70%. Further discussion on air quality impacts at ecological receptors is provided in a supplementary environmental statement[4] (outside the scope of AQMAU).
- For the human health risk assessment, the risk to health due to emissions from the ERF plant are negligible.

2.2 We audited the assessments and have made several observations in relation to their methodology and assumptions detailed in section 3. We conducted our own check modelling, built alternative models and performed sensitivity analysis to our observations. As a result of our checks, we find that we do not agree with the applicant's numerical predictions and cannot agree with their conclusions.

2.3 Our analysis consulting software validation documents, published guidelines on modelling algorithms and extensive sensitivity analysis to several input parameters indicate that the applicant's predictions are likely to underestimate reasonably frequent peak concentrations at southwest receptors due to steep terrain gradients (refer to details in sections 3.2 and 3.23). We therefore recommend a re-evaluation of the impacts to air quality from the proposed operation, evaluating uncertainties and potentially considering the use of alternative modelling software.

[1] Powerfuel Portland Limited Appendix D.2: Process Emissions Modelling (S2953-0030-0005RSF), Fichtner Consulting Engineers Ltd, August 2020
[2] Abnormal Emissions Assessment. Portland Energy Recover Facility. Ref: S2953-0320-0009HKL, September 2020
[3] Human Health Risk Assessment Portland Energy Recover Facility Version 2, Environmental Resources Management Limited, August 2020.
[4] Portland Energy Recovery Facility (ERF). Environmental Statement. ES Chapter 10: Natural Heritage

2.4 Our results indicate that we cannot rule out potential exceedances of short-term environmental standards for human health when abnormal operations occur or potential exceedances of critical levels and loads at ecological receptors, in particular:

- Although the probability of unfavourable meteorological conditions coinciding with the ERF emitting at plausible abnormal emissions is likely to be low, we cannot rule out exceedances of the hourly hydrochloric acid (HCl) ES at locations of exposure at the top of the Island. We were able to replicate the consultant's emissions based on their assumed 900[5] mg/Nm^3 as plausible HCl emission concentration.
- We cannot rule out potential exceedances of the annual and daily NO_X critical levels at the Isle of Portland to Studland Cliffs SAC and Isle of Portland SSSI. The 1-km squared average background tile, where the designated site is located already exceeds the annual NO_X critical level of 30 µg/m^3. Although the consultant's numerical PCs are above the insignificance criterion, they are likely to be underestimated and cannot be used for permit determination.
- We cannot rule out exceedances of the nutrient nitrogen deposition minimum critical loads at Chesil and Fleet SAC and the Isle of Portland SSSI, where background levels already exceed the minimum critical loads (only for woodland features). Although the consultant's PECs are above the minimum critical loads, we do not recommend their PCs to be used for permit determination.

3. Evidence for Conclusions

Air Quality Assessment

3.1 The proposed facility is located at sea level in the northeast of the Isle of Portland with an 80 m stack height. There is an ecological site with various designations located close to the site boundary. The ecological site, located in the southwest quadrant of the dispersion site, includes gradually increasing elevations rising to the top of the island, where there are steep gradients above 10%. At the top of the island, there are various short-term and long-term locations of exposure for human health.

3.2 The consultant carried out the assessment using ADMS 5.2 air dispersion modelling software. Although ADMS uses a skewed Gaussian distribution to characterise dispersion under convective conditions, the ADMS user guide[6] states that moderate gradients of up to 1:3 can be modelled. Some human receptors and particularly the Isle of Portland ecological site are associated with steeper terrain gradients. According to US EPA[7], in very rugged hilly or mountainous terrain, along coastlines, or near large land use variations, the characterization of the winds is a balance of various forces, such that the assumptions of steady-state straight-line transport both in time and space (such as those in ADMS) are inappropriate. In such cases, the US EPA recommends that models should be chosen to fully treat the time and space variations of meteorology effects on transport and dispersion with input data varying within a three-dimensional wind field i.e., such as CALPUFF a non-steady 3D meteorological wind field. AERMOD, another modelling software used for regulatory purposes, considers less sophisticated terrain algorithms[8] than CALPUFF, however, it is limited in the characterisation of mechanical turbulence from varied land use such as that of the dispersion site[9]. We considered these

[5] 273K, 101kPa, 11% Oxygen, 0% moisture
[6] ADMS 5 Atmospheric Dispersion Modelling System User Guide Version 5.2. Cambridge Environmental Research Consultants Limited, November 2016.
[7] Revisions to the Guideline on Air Quality Models. US Environmental Protection Agency, Appendix W January 2017. Available at https://www.epa.gov/sites/default/files/2020-09/documents/appw_17.pdf
[8] A complex terrain dispersion model for regulatory applications. A. Venkatram. Atmospheric Environment 35 (2001) 4211-4221. February 2001.
[9] User's Guide for the AERMOD Meteorological Preprocessor (AERMET). US Environmental Protection Agency. Ref: EPA-454/B-21. April 2021.

as key factors to justify our sensitivity to alternative modelling software, AERMOD and CALPUFF, considering sensitivity[10] to ADMS to check the consultant's numerical predictions and evaluate uncertainties (see discussion in section 3.23).

3.3 The consultant used five years of meteorological data observed at Portland meteorological station recorded between 2014 and 2018. They claim that the station is located approximately 5 km south-west of the proposed facility. Although we found contradictory information on the exact location, we believe this is an appropriate location based on the predominant south westerly winds influenced by the sea. The consultant's selected meteorological data is likely to be reasonably representative of the region, however, based on the location of the stack, we cannot rule out whether there would be more frequent north easterly winds that would drive the plume toward receptor locations. We have therefore conducted sensitivity analysis using 5 years of alternative meteorological data observed at Portland Heliport (located 1.5 km north-west) and 4 years of modelled meteorological data extracted at the location of the stack. Alternative met data or recorded years show reasonably similar southwest wind directions to those presented in the consultant's Annex A, with variable frequency of north easterly winds.

3.4 The consultant selected a minimum Monin-Obukhov (MO) length for the dispersion site of 10 m, representative of small towns below 50,000 inhabitants. This means that in stable conditions the MO length will not fall below 10 m, preventing the atmosphere from becoming very stable, overall decreasing vertical mixing of pollutants. The default minimum MO length is 1 m corresponding to rural areas. We have evaluated the atmospheric stability estimations from each of the models to evaluate the implications of this.

3.5 Surface roughness is a model input parameter related to the height of interfering obstacles used to express the land surface characteristics influencing mechanical turbulence and vertical mixing, particularly in neutral and stable atmospheric conditions. AERMOD and ADMS algorithms would account for this differently. The land use surrounding the ERF varies throughout the modelling domain and the consultant considered variable surface roughness shown in figure 2 of Annex A with 50 m resolution from 0.0001 m (sea) up to 0.5 m (urban and industrial areas). Having consulted various Geographic Information Systems, we note that a surface roughness of 0.02 m (short grass) used by the consultant is unlikely to be representative of the area rising to the top of the island. We have performed sensitivity to ADMS, AERMOD and CALPUFF with modified consultant's variable surface file, surface roughness values from approximations indicated in the US EPA AERMET guidance, and variable roughness obtained from CORINE Land Cover[11] database (with 100 m resolution).

3.6 The site is in the Isle of Portland close to sea level with inland terrain features above 1 in 10. The consultant has included terrain data covering 5.25 km^2 with a 50 m resolution presented in table 10, however, as discussed in previous point 3.2, ADMS might not be suitable for such steep terrain features. We have therefore considered results from modelling software with alternative terrain algorithms such as CALPUFF and AERMOD. We conducted sensitivity analysis using our 50 and 30 m resolution terrain data obtained from the UK Ordnance Survey National Transfer Format (NTF) and Shuttle Radar Topography Mission (STRM).

3.7 The consultant's assessment is based on the maximum values of the best available technique (BAT) associated emission levels (AELs) from the BAT conclusions for waste

[10] In modelling, sensitivity means variability of inputs versus variability of outputs (i.e. predicted concentrations)
[11] Copernicus Land Monitoring Service. CORINE Land Cover available at https://land.copernicus.eu/pan-european/corine-land-cover [Accessed on September 2021]

incineration[12] and the half-hourly Emission Limit Values (ELVs) set out in Annex VI, Part 3 of the Industrial Emissions Directive[13] (IED). The stack emission data are presented in tables 7 and 8. We observe:

- Although the stack height internal diameter is 2 m in the report with the exhaust gases at a velocity of 17 m/s, the consultant confirmed that the modelled values of 1.85 m and 20 m/s are the correct parameters. We have therefore not considered sensitivity to alternative source parameters in this case.
- An ammonia emission concentration of 8 mg/Nm^3 (at 273K, 101 kPa, 11% O_2, dry) and a stack height of 80 m were selected as outcome from the stack height assessment in section 5. We assumed these parameters in our audit modelling.
- We were able to replicate the consultant's emission rates based on the emission concentrations presented in table 8, except for the half-hourly hydrogen fluoride (HF) and daily ammonia. We obtain approximately 7 and 1.3 times higher mass emission rates than consultants' for the given emission concentrations in table 8. We have considered these in our assessment.

3.8 Airflow around buildings may create zones of turbulence and downward mixing on the lee side. To account for the downwash effect, the consultant considered the 8 building structures presented in table 11 and shown in figure 4 of Annex A. The AERMOD and ADMS building algorithms would treat these structures differently, affecting resultant predicted concentrations. In our analysis, however, we note that only half of these structures are likely to contribute to downwash effect due to their heights relative to the stack. We have considered these aspects in our analysis.

3.9 The consultant modelled predictions across a 4.2 km x 3 km grid with a resolution of 60 m per square as presented in table 9. In addition to the modelled grid, five discrete receptors were considered to represent human exposure[14] and another eight receptors were included in the human health risk assessment. We have included additional locations of exposure in our sensitivity analysis, particularly short-term locations of exposure at the top of the island.

3.10 The consultant considered either background data from air quality sites across the UK or Defra background maps summarised in table 13. We have reviewed pollutant background concentrations, with particular focus on locally recorded values presented in the Annual Status Report for Weymouth & Portland[15] and pollutants background values available at Air Defra website[16].

3.11 The consultant reported long-term and short-term process contributions (PCs) and predicted environmental concentrations (PECs) in section 7 of the AQA. We highlight:

- Consultant's numerical predictions indicate that either PECs are below the relevant environmental standards (ES) or PCs are below 1% and 10% the long- and short-term ES, respectively, indicating that PCs are insignificant. We have evaluated the uncertainty in these predictions.
- Consultant's analysis in table 17 indicates that applying the same increased emission ratio from daily IED ELV to half-hourly IED ELVs to calculate half-hourly BAT-AELs, short-term PCs are insignificant at any residential receptor. We have based our

[12] COMISSION IMPLEMENTING DECISION (EU) 2019/2010 of 12 November 2019 establishing the best available technique (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and the Council, for waste incineration.
[13] DIRECTIVE 2010/77/EU OF THE EUROPEAN PARLIMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)
[14] Portland ERF Modelling Results at Discrete Receptor Locations, Fichtner Consulting Engineers Ltd, May 2021
[15] LAQM Annual Status Report 2019. Weymouth and Portland Borough Council. August 2019
[16] UK AIR: Air Information Resource. Available at https://uk-air.defra.gov.uk/ [Accessed on September 2021]

assessment on the half-hourly ELVs and have disregarded the consultant's approach to short-term emissions assessment. This leads to proportionally higher short-term PCs.

- As presented in tables 18 and 19, each metal of the group 3 has been modelled assuming a percentage of the BAT-AEL (i.e. 0.3 mg/Nm^3) corresponding to the maximum proportion from the table A1 of the metals guidance[17]. We do not agree with this approach because a lower emission of the group does not necessarily mean a lower proportion per metal. We have therefore tested sensitivity to proportionally higher mass emissions assuming the maximum emission concentrations in table A1.

- We note that the consultant has assessed emissions of $PM_{2.5}$ against an annual mean environmental standard of 25 µg/m^3. The environmental standard changed to 20 µg/m^3 in 2020[18]. These lead to minor differences comparatively.

- New Environmental Assessment Levels have been published for arsenic (changing from 3 to 6 ng/Nm^3 annual average), benzene (changing from 195 µg/m^3 hourly to 30 µg/m^3 daily) and chromium VI (changed from 0.0002 to 0.00025 µg/m^3 annual averages). We have considered these in our assessment.

3.12 In accordance with Article 46 (6) of the IED, the facility would be permitted to operate unabated above ELVs for a continuous period of no more than 4 hours and up to 60 hours per year, thus short-term impacts are of most concern during abnormal operations. The consultant provided the concentrations used to derive abnormal emissions in table 1 of the abnormal emissions assessment and we were able to replicate their emission rates. According to tables 3 and 4, the consultant's predicts for abnormal operations short- and long-term PCs that are either insignificant or PECs that are below the ES. We have evaluated these.

Human Health Risk Assessment

3.13 An assessment of COMEAP Dose-Response Factors of PM_{10}, $PM_{2.5}$, SO_2 and NO_2 has been undertaken, however, this is not required because these pollutants are assessed against the environmental standards which are considered protective.

3.14 The consultant used proprietary software Lakes Industrial Risk Assessment Program (IRAP) to conduct their Human Health Risk Assessment (HHRA) of dioxins and furans and metals emitted from the facility. The IRAP implements the US EPA Human Health Risk Assessment Protocol[19] (HHRAP). We have considered our own HHRA tools. We highlight:

- The Environment Agency has agreed to a position with Public Health England (PHE) that a metals assessment is only needed if fish consumption is a significant pathway; otherwise, the ES for metals are protective for human health. We have checked a number of sources[20] to investigate potential fish intake from members of the public and agree that the ingestion of fish is unlikely to be a pathway.

- The consultant has considered direct inhalation, ingestion of soil, and ingestion of home-grown intake through food grown at the property as the potential significant exposure pathways at eight discrete child and adult receptors. Impacts from consumption of locally caught fish, drinking water and the consumption of locally

[17] Guidance on assessing group 3 metal stack emissions from incinerators, Version 4.
[18] Guidance Air emissions risk assessment for your environmental permit. Available at https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions [Accessed on September 2021]
[19] United States Environmental Protection Agency – Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Sept 2005. Available at www.epz.gov/osw [Accessed on September 2021]
[20] The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) website available at https://cefas.cefastest.co.uk/eu-register/?filter= [Accessed on September 2021]

grown beef and pork are not included in the assessment. We have assumed that food is grown and sourced locally from the maximum predicted point of impact within the modelling domain for a conservative assessment.

3.15 The consultant has assessed emissions of dioxins and furans assuming that all dioxins are emitted as 2,3,7,8 TCDD, the most hazardous congener, presenting emissions in table 3.1. No dioxin-like PCBs were considered. We have based our assessment on the group of congeners and assumed dioxin-like PCBs emissions based on benchmark values from monitored facilities.

3.16 The consultant has carried out an assessment of carcinogenic and non-carcinogenic risk using the US EPA methodology, including a range of metals emissions as well as dioxins and furans. We would expect the applicant to compare intakes against the UK Committee on Toxicity (COT) Tolerable Daily Intake[21] (TDI) of 2 pg WHO-TEQ/kg(BW)/day. We note that the applicant's intake values (as a ratio) presented in table 3.3 would be below the 10% Public Health England threshold criteria when compared against the UK COT TDI, excluding dioxin-like PCBs. We have undertaken our own HHRA.

Ecological Assessment

3.17 The consultant's assessment of ecological impacts identified 3 European designated sites within 10 km, 3 UK designated sites and 9 local nature sites within 2 km of the proposed facility, listed in Table 6 of the AQA. We note that:

- Our checks indicate that the consultant did not identify the ecological site Studland to Portland Special Area of Conservation (SAC), although their figure 1 in Annex A shows this to be the same as Isle of Portland to Studland Cliffs SAC. However, Air Pollution Information System[22] (APIS) shows that the habitat at this ecological site (i.e. reefs) is not sensitive to air pollutants.

- The area of the ecological sites Isle of Portland to Studland Cliffs (SAC) and Isle of Portland Site of Scientific Interest (SSSI) starts approximately from the site boundary rising to the top of the island with terrain gradients above 1 in 10 and covering most of the southwest quarter of the dispersion site. As a result, we have evaluated impacts through the area of the ecological site with contour plots.

3.18 The consultant has assessed the impacts of NO_X, SO_2, ammonia (NH_3) and hydrogen fluoride (HF) against the respective critical levels, presenting their results in tables 22 to 23 of annex B. For SO_2 and NH_3, the more stringent critical levels were considered for the Isle of Portland to Studland Cliffs SAC, the Isle of Portland SSSI and Nicodemus Heights SSSI due to the presence of lichens and/or bryophytes at the ecological sites. We consulted APIS to confirm critical levels and backgrounds. We observe:

- Consultant's annual ammonia PCs are 2.5% and 1.1% of the critical level of 1 $\mu g/m^3$ at the Isle of Portland to Studland Cliffs SAC and Isle of Portland SSSI, and Nicodemus Heights SSSI, respectively, indicating that PCs are not insignificant. Their concentrations in table 22 are given in ng/m^3, however, this is likely to be a typographical error.

- Consultant's NO_X PCs are 1.3% and 15.3% of the annual and daily NO_X critical levels respectively at both the Isle of Portland to Studland Cliffs SAC and Isle of Portland SSSI, indicating that PCs are not insignificant. The consultant assumed a NO_X background of 11.5 $\mu g/m^3$, however, we note that the annual NO_X background

[21] Committee on toxicity of Chemicals in Food, Consumer Products and the Environment. Tolerable Daily Intake (TDI) of 2 picogrammes toxic equivalent (TEQ) per kilogramme human body weight per year
[22] Air Information Pollution System (APIS) available at http://www.apis.ac.uk/ [Accessed on 2021]

corresponding to the 1-km averaged squared tile where the Isle of Portland to Studland Cliffs SAC and the Isle of Portland SSSI is located already exceeds the annual critical level of 30 μg/m^3.

3.19 The consultant presents nutrient nitrogen and acid deposition calculations in tables 25 to 28 and critical loads in table 29. We have calculated nutrient nitrogen and acid depositions following AQTAG06[23], selecting critical loads from APIS. We highlight:

- Consultant's nutrient nitrogen deposition PCs in table 27 are 2.7% and 1.1% of the critical loads at the Isle of Portland SSSI, indicating that PCs are not insignificant. Since deposition velocities are higher for woodland than for grassland, if woodland only, backgrounds are already exceeding the minimum critical loads and consultant's PECs are above 100% the minimum critical load. We have evaluated these.

- Consultant's nutrient nitrogen deposition PC is 0.9% of the minimum critical load at the Chesil and the Fleet SAC, indicating that PCs are at the insignificance threshold criterion. We note that backgrounds are already exceeding the minimum nutrient nitrogen critical load and consultant's PECs are just above 100% of the minimum critical load.

- Despite their numerical predictions indicating exceedances, the consultant did not interpret the results presented in tables 26 to 27 or present a discussion on uncertainties in any section of the air quality assessment report. They refer to an ecological interpretation of impacts at ecological sites in the Environmental Statement Chapter 10[4], however, this is outside the scope of the modelling exercise.

AQMAU Checks and Results

3.20 We carried out check modelling based on the consultant's ADMS 5.2 modelling files. Our checks include sensitivity to model input parameters, to our own air dispersion model of the site using alternative modelling software and analysis to the following:

- Alternative modelling software Breeze AERMOD and AERMOD View (US EPA executable version 19191) with AERMET meteorological data processor; alternative model in CALPUFF View (US EPA approved version) using CALMET meteorological data processor (refer to section 3.2).
- 5 years of meteorological data observed at Portland Heliport between 1993 and 1997 from the UK Met Office, 3 years of data observed at Isle of Portland between 2010 and 2012 extracted from the US National Oceanic and Atmospheric Administration (NOAA)[24], 3 years of modelled data from the UK Numerical Weather Prediction (NWP)[25] extracted at the location of the stack and 1 year of modelled data from 5th-generation prognostic meteorological mesoscale model MM5 2001 extracted at the location of the stack (refer to section 3.3).
- Evaluation of the calculated boundary layer for each worse-case year and estimations on atmospheric stability per modelling algorithm (refer to section 3.4).
- Consultant's variable surface roughness file, sensitivity to higher values and a range of lower and higher surface roughness across the modelling domain, sensitivity to alternative surface roughness characterisation from CORINE database and alternative modelling software (refer to section 3.5).

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[23] AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air, March 2014 (Habitats Directive)
[24] National Oceanic and Atmospheric Administration (NOAA) https://www.noaa.gov/ [Accessed on August 2021]
[25] A numerical forecast atmospheric model from the UK Met Office based on the UK forecast model with a mesoscale resolution of 4km.

- Consultant's complex terrain in ADMS, our own complex terrain data covering a larger area and sensitivity to alternative terrain algorithm i.e., CALPUFF and AERMOD with 50 m resolution data from NTF and 30 m resolution data from STRM (refer to section 3.6).
- Sensitivity to the highest pollutant emission rates derived from source term parameters in table 7 and emission concentrations in table 8 (refer to section 3.7).
- Evaluation of the influence of building structures and downwash in the predictions (refer to section 3.8).
- Additional sensitive receptors, particularly at the top of the island (refer to point 3.9), evaluation of the impacted areas at ecological receptors (refer to point 3.17) and existing pollutant background concentrations (refer to point 3.10).
- Sensitivity to the maximum group 3 metals emission concentrations presented in table A1 of the metals guidance (refer to section 3.11).
- Assessment against alternative environmental standards published in our guidance for $PM_{2.5}$, arsenic, benzene and chromium VI (refer to section 3.11).
- Screening and detailed ecological impact assessment consulting gridded critical load and level values from APIS and mapping systems from Natural England (refer to points 3.17 to 3.19).
- Assessment of dioxins and furans, and dioxin-like PCBs intake from all pathways at the maximum at the grid, including fish and drinking water consumption, against the COT TDI of 2 pg WHO-TEQ/kg BW/day (refer to sections 3.13 to 3.16).

3.21 As a result of our checks and sensitivity analysis considering alternative modelling software, we found that we cannot agree with consultant's conclusions because we consider that air quality impacts are underestimated (see discussion in section 3.23). We found:

- With regard to human receptors, we found that we cannot rule out exceedances of the hourly HCl ES at short-term locations of exposure at the top of the island during abnormal operations. Our checks indicate that exceedances are unlikely for the rest of environmental standards and operations.
- With regard to ecological receptors, our checks indicate that PCs are not insignificant and much higher than the consultant's values, at locations where backgrounds are already exceeding the critical levels and critical loads:
    - Annual and daily NO_X critical levels at the Isle of Portland to Studland Cliffs SAC and Isle of Portland SSSI, where background NO_X already exceeds the annual critical level of 30 $\mu g/m^3$.
    - Nutrient nitrogen deposition minimum critical loads at Chesil and Fleet SAC and the Isle of Portland SSSI (only if woodland features), where background levels already exceed the minimum critical loads.

3.22 For the rest of pollutants and environmental standards, we have found no evidence of exceedances at locations of exposure for human health or exceedances of any critical level or load at the rest of ecological receptors. Our HHRA indicates that PCs are likely to be below 10% of the COT TDI of 2 pg WHO-TEQ/kg(BW)/day, therefore, predicted risks from dioxins and furan and dioxin-like PCB emissions are below the PHE criteria for the protection of human health. Nonetheless, we advise against using the applicant's numerical predictions in the decision document.

Discussion

3.23 The consultant did not present a discussion on uncertainties as required in our modelling guidance[26]. Within our sensitivity analysis, AERMOD predictions were higher than ADMS, making a difference to conclusions. In reviewing software validation documents for cases with similar characteristics[27, 28, 29] (i.e. buoyant source, relatively tall stack, receptors located in elevation with terrain gradients), although experiments were based on traces of pollutants, comparisons between modelled and observed concentrations indicated that ADMS underestimated modelled predictions at elevated receptors associated with gradients. This underpins the mention in the ADMS documentation that only moderate terrain gradients of up to 1:3 can be modelled. Within our analysis at the worse-case receptors, the 80 m stack height plus our estimated plume rise indicates that for specific meteorological conditions, the plume will impact at steep parts of the terrain. Software algorithms will treat this situation differently depending on approximations to atmospheric conditions and whether the plume would have enough momentum to move upwards in its entirety, partially or downwards. Due to such a complex situation, for regulatory purposes, we consider we cannot fully categorise either algorithm solution as invalid. In reviewing the evidence, we feel that the consultant's lack of consideration of modelling uncertainty in this situation misrepresents the predicted impacts as reasonable worst cases. As a result of our analysis, we consider the consultant should address modelling uncertainty.

[26] Guidance: Environmental permitting: Air dispersion modelling reports. Available at https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports [Accessed on September 2021]

[27] AERMOD Model Formulation and Evaluation. US Environmental Protection Agency. EPA-454/B-21-003. April 2021.

[28] ADMS 5 Complex Terrain Validation. Tracy Power Plant. Cambridge Environmental Research Consultants. November 2016. Available at https://www.cerc.co.uk/ [Accessed on September 2021]

[29] Performance evaluation of AERMOD, CALPUFF, and legacy air dispersion models using the Winter Validation Tracer Study dataset. S. Rood. 2014